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(54) Touch contacts for hearing aid volume control.

(57) Touch contacts 20 for touch sensitive amplification adjustment of a hearing aid H adapted to be inserted in the ear canal are located adjacent the battery door 16 on the face plate 12 of the hearing aid, allowing the touch contacts 20 to be easily touched when the hearing aid is installed. Preferably the touch contacts 20 are located on the edges of guides 18 adjacent the battery door 16, forming the most prominent point on the hearing aid when installed.

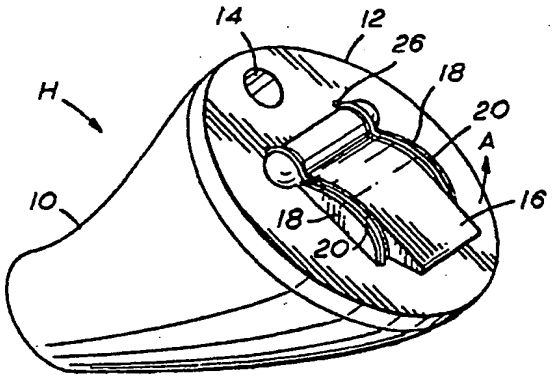

FIG. 1

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TOUCH CONTACTS FOR HEARING AID VOLUME CONTROL

The present invention relates to hearing aids and, more particularly, to touch contacts for use in controlling the volume of a hearing aid.

Hearing aids are miniaturized devices generally placed in or behind the ear and are used to amplify sounds for the hearing impaired. Hearing aids include some means of volume control to allow battery life to be extended and to allow for comfortable listening levels by the user.

Conventionally, the volume control has been a variable resistor or potentiometer and is mounted to a plate or face plate on the hearing aid so that a knob or screw adjuster attached to the wiper arm of the variable resistor is used to change the resistance and thereby change the amplification levels of the hearing aid. Given the small sizes of hearing aids, particularly in-the-ear hearing aids, this knob or screw adjuster used for volume control is very small and very hard to use, particularly for users which also have decreased sensitivity and dexterity. It is desirable to have a hearing aid volume control which is easier to use than the very small knobs conventionally used with variable resistors.

A touch sensitive hearing aid was disclosed in U.S. patent 4,679,240, by this inventor. The design uses at least three separate contacts for use with a touch sensitive volume control circuit. One contact is used in combination with the common contact to signify a desired increase in the volume, while a second contact is used in combination with the common contact to signify a decrease in the desired volume or amplification levels of the hearing aid. While this design improved over the use of the knobs and variable resistors of previous designs, the use of three or four touch contacts required a minimum physical spacing on the hearing aid, which for hearing aids of different or smaller configurations is difficult to obtain.

Therefore it is desirable to have a method of volume control of a hearing aid which is touch sensitive, requires less surface area than the one in the referenced patent and is easy to locate with the tip of a finger in the confined space and location of a hearing aid.

The touch contacts of an embodiment of the present invention are adapted to be placed in a small environment and yet be readily accessible by the finger of the user to allow ease in changing the volume of the hearing aid. The circuitry of the hearing aid is designed to require the use of only two touch sensitive contacts for allowing volume changes of the hearing aid. Touching the two contacts a first time and holding the contacts increases the volume, while touching the contacts a second time and holding the contacts results in a decrease in the volume of the hearing aid.

The touch contacts are preferably located adjacent a battery door of the hearing aid. The battery door commonly has located adjacent to it guides or guide lips which extend past the battery door, the guides thereby forming the most prominent portion of the hearing aid. The touch contacts are preferably formed of gold-plated wire which is placed along the edge of each guide, thereby placing the touch contacts in the most prominent position of the hearing aid and yet not requiring additional space on the face plate or cover of the hearing aid. The user merely touches the face plate of the hearing aid, which generally results in the touching of the battery door and adjacent guides. Since the face plate is usually the most prominent and accessible portion of the hearing aid, the two contacts are easy to touch to effect the appropriate and desired volume change.

A better understanding of the invention can be obtained when the detailed description of the exemplary embodiment set forth below is considered in conjunction with the following drawings, in which:

Figure 1 is a perspective view of an embodiment of a hearing aid incorporating the touch contacts according to the present invention;

Figure 2 is a top view of an embodiment of a face plate containing touch contacts according to the present invention;

Figure 3 is an enlarged view of portions of Figure 2;

Figure 4 is a partial side view of an embodiment of a face plate and battery housing including touch contacts according to the present invention; and

Figure 5 is an embodiment of an electrical block diagram of the circuitry of a hearing aid having touch contacts according to the present invention.

Referring to Figure 1, an embodiment of a hearing aid in accordance with the present invention is generally designated by the letter H. The hearing aid H contains a housing portion 10 which is adapted to be inserted in an ear canal (not shown) and perform the function of an in-the-ear hearing aid. A face plate 12 forms the portion of the hearing aid H which is visible or accessible when the hearing aid H is installed in the ear. A microphone port 14 is formed in the face plate 12 for allowing sound to be transmitted to a microphone 40 (Fig. 5) contained in the housing 10. A battery door 16 is pivotally connected to the face plate 12 and opens in the direction of arrow A to

allow removal, changing or insertion of a battery 42 that is necessary for the hearing aid circuitry to function. A pair of battery guides 18 project from the outer surface of the face plate 12 and are located adjacent to the battery door 16 and perpendicular to the face plate 12. The guides 18 effectively provide and form sides to the battery door 16 and hold the battery 42 in place as the door 16 opens and closes. A pair of touch contact wires 20, described in greater detail below, are positioned on the edge of the guides 18.

Fig. 2 shows a face plate assembly F having a battery door 16 installed on an uncut face plate 22. The face plate assembly F initially starts out as a large round disk on which the battery door 16 and the guides 18 are installed. A face plate assembly of this type is available commercially from sources known to those skilled in the art. The touch contact wires 20 are then added. The face plate 22 is cut by the hearing aid manufacturer to form the face plate 12 shown in Fig. 1, which is attached to the housing 10 of the hearing aid H.

The guides 18 include hinge assemblies 24 (Fig. 3), which allow the battery door 16 to pivot away from the face plate 22 in the direction of the arrow A (Fig. 1) and allow easy changing of the battery 42. The guides 18 have a discrete thickness and are formed perpendicular to the face plate 22 to form sides of the battery door 16. This structure allows the battery door 16 to project above the face plate 22 a short distance so that the door 16 can easily be opened and closed by grasping a handle portion 19. Terminals 28 (Fig. 4) for contacting the battery 42 so that power can be supplied to the circuitry of Fig. 5 are located beneath the face plate 12 in the hearing aid H.

The touch contact wires 20 are installed along the outer edges of the guides 18 and enter the body of the hearing aid H through holes 26 formed in the face plate 22. Since the guides 18 project above the battery door 16 (Fig. 4), the touch contact wires 20 are located at the most prominent portion of the hearing aid H. This location allows the user to touch both of the touch contact wires 20 easily, thereby allowing the hearing aid amplification circuitry C to sense the touch of a finger for changing the volume as described below.

The amplification circuitry C (Fig. 5) is adapted for use with two touch contact wires 20. Sound waves are received by a microphone 40, which produces an output signal 100. The microphone output signal 100 is filtered by a capacitor 102 to remove any direct current components of the signal 100 and is provided to the input 104 of a first class A amplifier 106. A series combination of two resistors 110, 112 is connected from the output 108 to the input 104 of the amplifier 106 to set portions of the feedback resistance and therefore gain of the amplifier 106.

Connected across one of the resistors 110 are the output terminals 116 of a programmable transconductance block 114. The output terminals 116 are connected to a controlled resistance internal to the transconductance block 114. The transconductance block 114 uses a capacitor 118 connected to ground to set an oscillator frequency. Additionally, the transconductance block 114 is connected to each of the touch contact wires 20. The transconductance block 114 varies the resistance developed between the output terminals 116 based on touches of the touch contact wires 20. Touching the touch contact wires 20 a first time causes the effective output resistance, and therefore amplifier 106 gain, to increase as the contact is maintained, at a rate based on the oscillator frequency. Touching the touch contact wires 20 a second time causes the effective output resistance, and therefore the amplifier 106 gain, to decrease as the contact is maintained. Repeated contacts of the touch contact wires 20 cause the resistance to change in an alternating manner as described.

The output terminals 116 of the transconductance block 114 are connected across the resistor 110 so that minimum and maximum gains of the amplifier 106 are set by the fixed resistors 110, 112 and damage to the hearing of the user is prevented, while at the same time not allowing the gain to go below a minimum usable amount and allowing the gain to be varied between the minimum and maximum amounts.

The output 108 of the first amplifier 106 is connected to the input 120 of a second class A amplifier 122. The second amplifier 122 is configured in a fixed gain arrangement through the use of two resistors 124, 126 connected to the amplifier 122. A speaker or receiver 46 is connected to the output 128 of the amplifier 122 and to the positive supply to provide a means for converting the amplified signal back into sound waves for transmission to the user's middle ear structure.

The touch contact wires 20 are preferably gold-plated for improved sensitivity and lack of corrosion. However, other conductive materials, such as silver or copper, would be suitable for this purpose. The wires 20 are affixed to the guides 18 by suitable adhesive means.

While the embodiment shown and described above uses a battery door 16 designed for a battery 42 which is inserted having its axis parallel to the plane of the face plate 12, it is understood that touch contact wires 20 can also be used with a hearing aid H having a battery door adapted for placement of the battery with the battery axis perpendicular to the plane of the face plate 12 and on other battery arrangements and battery door configurations which have been and can be developed.

The foregoing disclosure and description of the invention are illustrative and explanatory of the invention, and various changes in the size, shape, and materials, as well as in details of the illustrated construction may be made without departing from the spirit of the invention, all of which are contemplated as falling within the scope of the appended claims.

Claims

1. A hearing aid, comprising:
a housing, which includes a face plate adapted to be accessible when the hearing aid is installed in an ear canal;
a battery door located in said face plate for allowing a battery to be inserted into and removed from the hearing aid; and
circuit means in the housing for receiving and amplifying sound, said circuit means including two touch contacts for use in controlling the amplification level of the sound;
said touch contacts being located directly adjacent to and on opposite sides of said battery door on the accessible side of said face plate.

2. The hearing aid of Claim 1, wherein the battery door is adapted for insertion or removal of a battery whose axis is parallel to the plane of said face plate.

3. The hearing aid of Claim 2, further comprising:
flat guides perpendicular to said face plate and perpendicular to the battery axis and located adjacent to said battery door so as to provide sides to said battery door.

4. The hearing aid of Claim 3, wherein said touch contacts are located on the edge of said guides away from said face plate.

5. The hearing aid of Claim 4, wherein said guide edges extend farther from said face plate than said battery door.

6. The hearing aid of any one of the preceding claims, wherein said touch contacts are formed of gold-plated wire.

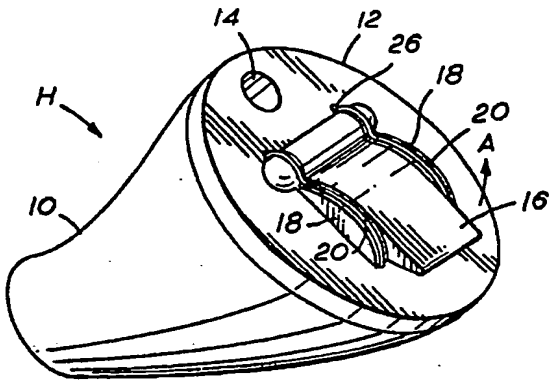


FIG. 1

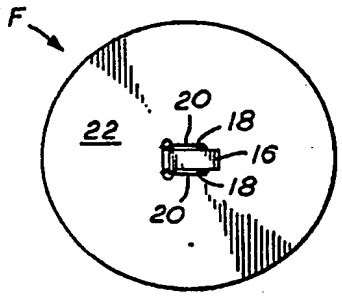


FIG. 2

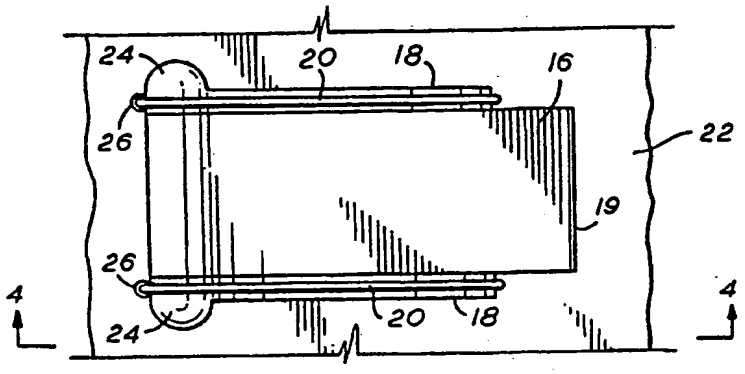


FIG. 3

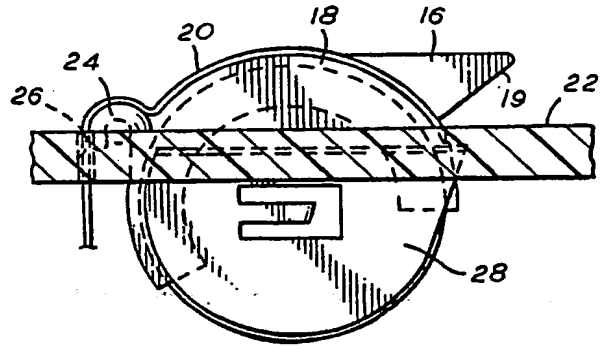
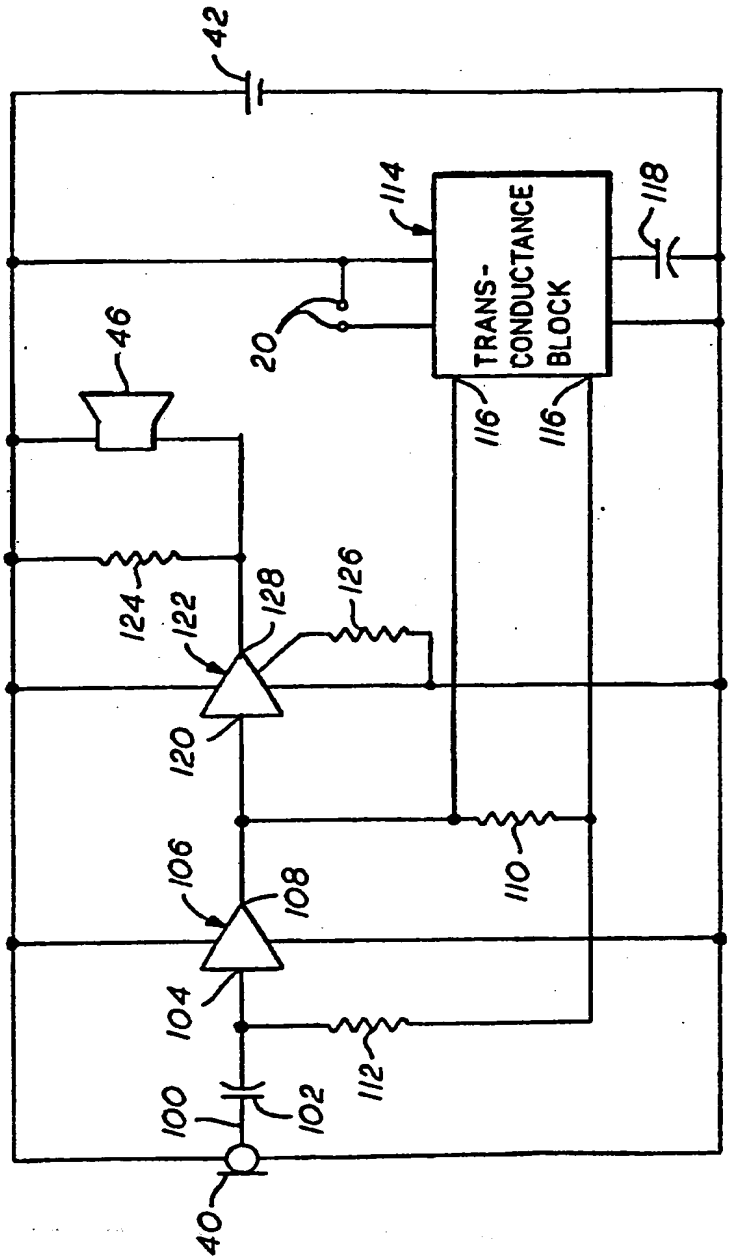


FIG 4


42
114
TRANS-
CONDUCTANCE
BLOCK
118
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116
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128
126
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106
108
110
104
112
100
102
40

FIG. 5